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## MEMORY SPAN: A REVIEW OF THE LITERATURE

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Although many researches have been undertaken in the field of memory span, both by experimental psychologists and by those in the field of mental testing, there has been no attempt to summarize or to systematize the findings of the investigators who have studied the various aspects of this subject. This paper has been undertaken with that end in view.

### I. HISTORY OF MEMORY SPAN TESTS

(1) *Early Anecdotes.* Stories of exceptional individuals have probably been told since the beginning of time, and reports about memory spans of such individuals are not lacking. There was a blind Swiss, for example, who was reputed to have been able to repeat a series of 150 numbers, either forwards or backwards, after a single hearing (91)! Other anecdotes are in the literature (8, 44, 47, 91, 130), but there was no real attempt at controlled observation, and none of the early writers realized the significance of what they had heard of or observed.

(2) *Nineteenth Century Studies of Memory Span.* In 1870, Oliver Wendell Holmes, in addressing the Phi Beta Kappa Society of Harvard University, said, ". . . in uttering a series of unconnected words or letters before a succession of careful listeners, I have been surprised to find how generally they break down, in trying to repeat them, between seven and ten figures or letters; though here and there an individual may be depended on for a larger number . . ." (61). Holmes, however, made no formal experiments on the phenomenon.

Sixteen years later, William James (70) wrote of "the present, . . . merely a dividing line between the past and the future . . .," but he did no

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experimental work on the problem. In the same year, Jacobs (68), an English philosopher, wrote, "There is . . . a certain number of syllables up to which each person can repeat . . . after only once hearing; and it is probable that this number varies with different persons." In 1887, he made the first formal experiment on "prehension" (69), discovering that the ability increased with age. Galton (48), in the same journal, noted that inmates of institutions for the feeble-minded possessed lower prehension ability than did the normal children tested by Jacobs. In 1888, Burnham (21) summarized some of these results in his comprehensive paper on memory.

From this time on, memory span research was more common. The most important work in the field since 1890 will be reviewed here, not primarily from the historical standpoint, but from the aspect of logical organization. If the reader be interested in historical summaries including some of the work on memory span, he is referred to the review by Burnham (21), and those by Young (144), Kuhlmann (78), Wylie (142), and McGeoch (87).

## II. WHAT IS MEMORY SPAN?

To define memory span, one must examine the question from two viewpoints, the functional and the structural.<sup>2</sup>

(1) *Functional Aspect.* Functionally, Binet (8) has defined prehension as "the maximum number of digits retained after a single hearing." But the definition, of course, need not be restricted to the use of digits. Humpstone (65) broadened this definition when he described memory span as "the ability to grasp a number of discrete units in a single moment of attention and to reproduce them immediately." Leaming (80) elaborated upon this: "It [memory span] appears to measure the number of discrete units over which the individual can successively distribute his attention and still organize them into a working unit." Watkins (133) stated that immediate memory ". . . is the capacity to repeat impressions which have not entirely disappeared from consciousness, the expression following immediately upon the impression." Strong (125) defined it as "a line of successive presents."

To generalize, memory span refers to the ability of an individual to reproduce immediately, after one presentation, a series of discrete stimuli in their original order. Practically any sort of material may be presented, such as digits, letters, words, and sounds, and almost any sense organ or combination of sense organs may be used to receive the impressions. Both of these variables will be discussed under subsequent headings.

(2) *Structural Aspect.* A structural definition of memory span is difficult to give, for one immediately is faced by the distinctions between the prerequisites for memory span, and the actual processes involved. Although an intact sense organ, an afferent tract, a central projection area, efficient association fibers, and a certain degree of attention are all involved, as Smith (119) points out, these terms do not describe the processes actually involved in memory span.

Processes of attention are involved, as McCauley (86), Gundlach, Rothchild, and Young (56), Cattell (28), T. L. Bolton (16), Johnson (72), and

<sup>2</sup> "Functional" in the sense of external or extrinsic behavior; "structural" in the sense of the processes involved (the intrinsic aspect).

others indicate. Certainly the subject must be able to distribute his attention over the series of stimuli, and concentration of attention is needed so that the mental processes may continue in the direction started. But the range or span of attention is distinct from memory span. Hunter (66) shows that attention span and memory span are alike in involving only one presentation of the stimulus, but that they differ in temporal duration of the stimulus. "If the stimulus is presented for one-fiftieth of a second, the experiment is classified as one on attention, whereas with longer exposure times, the behavior is classified as . . . memory." Motor aspects of attending are evident in the receipt of instructions and in the postural response of getting ready, as well as in the receptive attitude during the presentation of the series. Much may be said for the suggestion (56) that memory span be renamed "set."

"Associability" is also required in memory span. This term, originated by Humpstone (63, 64, 65), refers to the ability of the subject to group the series of elements together: to perceive relationships among the series in order to better reproduce them.

Still another process involved in memory span is that of imagery (20, 86, 97). The subject, in order to be able to reproduce the series presented, must be able to image the series. But memory span is not an after-image. Richet (110), as early as 1886, compared the memory span with the sensory after-image. He recognized that there was a difference, but believed the two to be comparable. According to common psychological belief, it is generally held that the sensory after-image depends upon activity not only in the brain, but also in the sense organ. Humpstone (64) actually calls memory span an after-image.

The actual reproducing of the series of stimuli involves the process of memory (28, 86). If the individual possessed no memory at all, reproduction of the series would be impossible. But Binet (8), in 1894, was probably the first specifically to point out that there was a difference between memory and memory span. Fernberger maintains (41) that memory span and memory are different in the length of time over which reproduction is possible. Memory span is transitory; memory is fairly permanent. In addition, the amount of material involved in memory span is ordinarily much less than the amount of material involved in memory. W. G. Smith (119) showed that memory span may be good and memory bad, or vice-versa, thus offering further proof that the two are distinct. Reproduction of the series also involves certain other "reproduction factors," such as language ability and arithmetical proficiency.

Now although memory span is dependent on all of the above functions, it seems clear that it is not any one of them (20, 64, 123). The question of whether the ability is dependent or independent is closely related to the present discussion, and hence is the next topic.

### III. IS MEMORY SPAN A GENERAL ABILITY?

(1) *Introduction.* A few workers (20, 63, 65, 97) regard memory span as an independent ability. Such attention factors as observation, distribution of attention, and description, and such reproductive factors as language ability, memory, and arithmetical efficiency may also be involved (20). Humpstone's independent

ability tested is "associability," or, "... the ability to grasp and associate a number of discrete units of perception in a definite order" (65). Memory and imagination are involved, but memory span itself is a specific ability.

Binet also holds that memory span is an independent ability (12), but that the ability tested is the "capacity for effort." This view assumes that memory span is a general<sup>3</sup> ability, and accordingly, that the type of material used or the sense organ or organs through which the material is received should have no effect either on the number of discrete units reproduced by the individual, or on the standing of the individual in relation to others tested for memory span.

(2) *The Type of Material.* There is practically no limit to the type of material that can be used in such a test.

Ideas, sentences, objects, pictures, noises, words, paragraphs, diagrams, and syllables are only a few of the many types of material that have been used, though as Bronner, Healy, Lowe, and Shimberg point out (19), the use of digits has preëmpted the field. For a discussion of the various types of material that have been used, the reader is referred to Jacobs (69), Travis (128), Calhoon (25), Lumley and Calhoon (82), Humpstone (65), Terman (126), Terman and Merrill (127), Cattell (28), Squire (121), Whitley (136), and Whipple (135).

It has been found that the type of material used in the test does definitely affect the results secured. In general, experimental results indicate that the most difficult material to reproduce is nonsense syllables, then letters, then digits, sentences and related words (25, 66, 82, 121, 132, 136). Bourdon (18) found that letters were easier for children to repeat than other materials; all materials were found to be of the same difficulty for subjects of from 14 to 20. The order indicates that at least two factors are involved in making some materials easier than others: familiarity with the material and "associability."

If all of the material used produced the same results relatively, the standing of the individuals in the group would not be affected by the type of material used. If the standing of the individuals in the group is affected by the type of material used, other factors remaining constant, we should expect a correlation of significantly less than 1.00 between results secured by use of different materials.

<sup>3</sup> That is, the same ability is said to be operating through the media of different sense organs and with different materials.



Henmon (60) secured the highest correlation coefficients for memory spans as ascertained for different types of materials when he reported a coefficient of .77 between "memory" for syllables and "memory" for numbers, and found the same correlation between "memory" for nouns and for syllables. Memory span as tested by nouns and numbers correlated only .20. Abelson (2) secured intercorrelations of from .34 to .66 for different types of material. Calkins (26) found that concrete objects produced higher memory span scores than did verbal stimuli, such as words. Fischler and Albert (42) were the first to treat this problem statistically. These investigators secured intercorrelations of from -.38 to .47 for different types of material. As a result of their experiment, they concluded that immediate memory was apparently not a general ability. They admit, however, that their results may be due to the fact that the same subject is attentive in one test, inattentive in another.

In none of these studies was there careful control of all experimental conditions. Thus, additional and more careful work is needed before conclusions can be drawn.

(3) *The Sense or Senses Through Which the Impression is Received.* The sense or senses through which the impression is received also appear to affect the memory span score as secured by the clinical or experimental test. The material may be presented through almost any sense organ or combination of sense organs.

It has been found that in general, for example, the adult will have a greater memory span with the visual than with the audito-vocal method, but that the child's score is higher with audito-vocal than with visual presentation (1, 59, 83, 103). Kirkpatrick (75) reported that visual presentation produced higher scores for immediate reproduction than did auditory or actual presentation of objects before the eyes.

The sense organ which receives the impression does, according to experimental results, make a definite difference in memory span score, at least in terms of the number of units reproduced. If the standing of the individual in relation to others is changed by results on memory span as attained through different sense organs, other factors remaining constant, correlations between the results should be significantly less than 1.00. But again, the experiments were not carefully controlled. Davis (37) found a correlation coefficient of only .49 between visual and audito-vocal presentation results. Hao (57) reported the coefficient to be .39 between visual and auditory presentation.

If the material is presented visually, successive or simultaneous presentation may be used. Münsterberg and Bigham (93), and Gates (53), found that adults profited more through simultaneous presentation, although Warden (132) reported that his college students profited more through successive presenta-

tion, and when movement was involved in the presentation, scores were even higher. Hawkins (59) verified the results of Münsterberg and Bigham (93) and Gates (53), and further reported that children secured higher scores through the use of successive rather than simultaneous presentation.

The memory span apparently increases as the number of sense organs through which impressions are received increases, except where distraction may occur, as in the results of Smedley (116).

Jones (74) found that a method of combining as many sense organs as possible was superior to any other method. This was said to be due to the fact that there are certain "visual," "auditory," and "motor" types of individuals. When all the possible sense organs are stimulated, each subject has the fullest possible advantage in the method of presentation. Münsterberg and Bigham (93) found that a series presented to 2 senses at the same time is much more easily reproduced than if given only to sight or to hearing. Smedley (116) concluded that the audito-visual-articulatory and the audito-visual-hand-motor memory were superior to visual presentation, which was superior to the audito method, but Chambers (31) could not substantiate this order.

Nichols (96) early demonstrated the possibility of using the tactual receptors for testing memory span, though Nichols had little idea of such an application of his work. The fact that memory span can be tested through the medium of any sense modality makes the Knox Cube Test a particular type of memory span test. In the Knox Cube Test, 4 blocks in a row are tapped by the examiner in a given order; the subject is then asked to tap the blocks in the same order. Obviously this comes under the functional definition of memory span, being simply a new method of presenting the stimuli. Davis (37) recognized this test as a type of memory span when he ran correlations with the results of the Knox Cube Test and results of memory span for digits.

(4) *Summary.* Results indicated in the 2 preceding sections show that substantially different spans are secured depending upon the type of material used, and the sense or senses through which the impressions are received. From all the evidence available, however, it would appear that memory spans for different types of material may be specific spans, rather than different aspects of a general span. Likewise, it appears quite probable that the memory span for each sense organ or combination of sense organs is a specific span. But the whole question is far from settled and is open for a real experimental attack, since it is more than possible that differences are due to inaccuracies in the methods rather than intrinsic differences in the mental processes involved.

For example, if the results obtained by methods using different materials could be freed of differences in the subjects' acquaintance with the materials, there might be no differences in relative results. This possibility is to be discussed further under a subsequent heading.

And again, if subjects who had practiced equally with the different sense organs could be obtained, results secured through different sense organs might give the same relative rankings for individuals. But there is a strong possibility that the imaginal endowment, as well as the imaginal type, would still affect the memory span, as Jones (74) suggests.

#### IV. FACTORS WHICH AFFECT MEMORY SPAN

There are a number of factors which definitely affect memory span; the effects of practically all of these factors have been investigated in statistical and experimental studies. Some of the factors are extrinsic, or present in the testing situation itself. These factors, if not carefully controlled, cause the memory span test to be statistically unreliable. Other factors are intrinsic in the individual, and it is these factors which are the basis of "true" memory span.

Though numerous factors affect memory span, the test is one that shows surprisingly high reliability. Results obtained by different investigators show that the reliability coefficients for memory span may be as low as .28 (15), or as high as .93 (22). Table I summarizes the reliability coefficients secured by different investigators for the more common methods of testing memory span.

TABLE I  
RELIABILITY COEFFICIENTS REPORTED FOR MEMORY SPAN

Investigator	Audito-Vocal for Digits	Visual for Digits	Audito-Visual for Digits
E. B. Bolton (15).....	.28		
D. Mitchell (90).....	.44, .47 <sup>4</sup>		
Hao (57).....	.52	.83	
Garrett (49).....	.80	.68	
Davis (37).....	.74	.84	
Wyatt (141).....		.76	
Burt (22).....		.70, .93 <sup>5</sup>	
Abelson (2).....			.73, .70 <sup>6</sup>

Reliability coefficients for other types of memory span reported in the literature vary from .70 (2) to .81 (141). Both the figures summarized in the table, and the data indicated in the preceding paragraph lead to an important conclusion regarding the use of memory span tests. The range of figures indicates that the extrinsic factors *can probably* be controlled carefully enough to make the test a reliable one.

<sup>4</sup> Two figures secured by use of two methods of scoring.

<sup>5</sup> Burt (22) secured the first figure with elementary school students, the latter with preparatory school students.

<sup>6</sup> Abelson's first figure was secured with girls, the second with boys.

*A. Extrinsic Factors*

(1) *Characteristics of the Material That is Used.* The characteristics of the material used will definitely affect the memory span score.

If, for example, the material is all closely related, it will be much more easily reproduced. This relationship of the material is called by Calhoon (23) the "coefficient of associability." In the use of digits, the figures must be so placed that none are in their natural or reverse order. There must be an avoidance of rotation, or of any numbers suggesting addition, subtraction, division, or multiplication (Brotemarkle, 20). Binet and Simon (11) state that no numbers which follow one another must be used beside each other. T. L. Bolton (16) and Bourdon (18), in their experimentation, were sure to ascertain that no digit came in its accustomed order, and that no digit was repeated. Terman (126) was not so careful in this respect in his 1915 revision of the Binet Test, but has taken greater care in his 1937 revision of the scale (127). Xilliez (143) analyzed the effect of the relation of the digits to one another, and noted that a negative interval (the interval is the difference between 2 digits which follow one another; it is positive if the second is larger, negative if the first is larger), is inferior, in terms of recall, to a positive interval. To summarize, the units of the series must not be presented in a manner that would facilitate groupings through the apperceptive background of the subject.

In addition, the units of the material must not be presented in groups. If the visual method is used, the material should be presented either one unit at a time (successive presentation), or all units at the same time (simultaneous presentation), for grouping would make it too simple for the subject to secure a memory span above his "true" one. Brotemarkle (20) and others emphasize the importance of the control of grouping. Chamberlain (30) has experimentally demonstrated that recall is stronger when the objects are presented in groups. However, even when grouping is eliminated in the presentation of the material, subjective grouping often occurs.

The material used should have approximately the same degree of familiarity for all subjects. Calhoon (23) and Whitley (136) both stress the fact that apperceptive background should be equalized for all subjects, as far as possible.

All of the subjects should have the same degree of familiarity with the items in the series. Do not, for example, test a child by the digit method if that child has never been taught numbers, for all available norms have been secured with the use of subjects acquainted with numbers.

(2) *Rhythm of the Presentation of the Material.* Closely related to the problem of presenting the stimuli in groups, is the presentation of the stimuli in rhythmic fashion. Most investigators point out that



the stimuli used in testing memory span should be presented with as little rhythm as possible (11, 18, 119, for example).

Probably the only experimental study of the effect of varying rhythm on memory span has been undertaken by Adams (3). Adams varied the rhythm in presenting a series of digits by using trochaic, iambic, dactylic, anapestic or amphibrachic rhythm, or no rhythm at all. He reported that his subjects (elementary psychology students at the University of Michigan) had higher memory spans in general when rhythm was used than when no rhythm was used. The effect of the different types of rhythm depended upon the sex of the individual, the females doing best with anapestic rhythm, the males with dactylic.

The fact that the introduction of rhythm into the presentation of the series of units does increase memory span is further verified by the results of those investigators interested in the "rhythmic span," in which the units are presented in rhythmic fashion (see 122, 124, for example). The effect of rhythm is to group the units in the series, again enabling the individual to secure a span higher than his "true" one.

(3) *Rate of Presentation of the Stimuli.* The speed with which the stimuli are presented has an effect on the memory span score attained. Terman (126) and other psychologists set the best rate of presentation of digits at a rate of slightly faster than 1 per second, while Lightner Witmer, in instructing clinical psychologists at the University of Pennsylvania, expressed his belief that the "natural rate of discharge" (the speed best adapted to the individual) should be used.

Actual experimental investigation also indicates that the speed of presenting the stimuli affects the score. Peatman and Locke (100) experimentally showed that the best rate of presentation for digits by either the audito-vocal or visual method was one digit per two-thirds of a second to one digit per second.

In the auditory digit test, Brotemarkle (20) believes that a rapid increase in the rate of presentation will result in an increase in score. Lumley and Calhoun (82) found that a decrease of speed enabled children of the seventh and eighth grades to raise their scores, but that in the other grades tested (third to twelfth) there was no consistent effect on performance. Other experimenters have found that a faster rate of presentation adversely affected memory span performance (56, 107). One investigator (Bergström, 6) reported that rate of presentation of the stimuli had no effect on the attained memory span.

Once again, a conclusion about the effect of the variable cannot be reached. Different research workers make various reports. More carefully controlled and standardized work is essential.

(4) *The Method of Scoring the Responses.* The method of scoring the responses also has an effect upon the apparent memory

span of the individual. Variations in scoring are common; scarcely two investigators have scored alike.

In the audito-vocal memory span for digits, for example, Terman (126) gave the individual 2 or 3 trials on any particular series, depending upon its length, and the subject was given credit for that length if one of the series was reproduced correctly. Starr (122) gave credit if 2 of 4 series were reproduced correctly at a given length. Humpstone (65) gave one trial at each level where the series was arranged in lengths varying from 3 to 10 digits. Credit was given for the longest series correctly reproduced. M. H. Young (145) showed that the number of trials given affects memory span attained. When a child was given 3 chances instead of 2 (with one series necessarily correct for credit), 55% of the subjects increased their span by one.

In the determination of reverse memory span, Starr (122) gave 4 chances at each length, and 2 of the 4 had to be correct reproductions for credit to be given. Terman (126) gave 2 or 3 chances at each level, and only one had to be correct. In the visual memory span for digits, Humpstone (65) gave only one chance at a series of given length, and to get credit, that series had to be absolutely correct.

Most investigators take the point of view that an incorrect series should not be scored at all. As Bergström (6) points out, if errors in a series longer than the span attained are scored, the true memory span is not ascertained. Other investigators feel, however, that all of the reproductions should be considered (55, 133).

Krueger and Spearman (77) take account of errors in their novel technique of scoring. They correlate the subject's reproduced series with the original stimulus series by use of Spearman's "footrule method." Thus the greater the error of the subject, the lower will be the correlation coefficient. Other methods of scoring errors are many and complicated, but these schemes and techniques will not be discussed in this paper.

(5) *Fatigue of the Subject.* Fatigue may be another extrinsic factor affecting memory span performance. Though the few investigators mentioning the effect of fatigue on memory span do not differentiate between mental and physiological fatigue and boredom, this does not immediately exclude their observations from consideration, though it does make them much less valuable. Hao (57) and Whitley (136) both believed fatigue to be a factor in their results, but Smedley (116) probably delayed experimental work on the problem when he pointed out that if one attempted to test the effect of fatigue, the subjects are apt to gain more through practice than they lose through fatigue.

As throughout the field of memory span investigation, more careful work is needed before the effects of fatigue can be conclusively shown.

(6) *Time of Day.* The time of day apparently is another extrinsic variable which produces differences in memory span. From

the available data, there is no way of telling whether the observed variations in memory span during the day are due to mental or to physiological fatigue, or boredom, or to some other factors not even considered as a possible cause. It is for this reason that the variable is considered under a separate heading.

Marsh (84) found wide individual variations in the time of day at which greatest efficiency appeared in memory span performance, while Winch (138) found that efficiency was greatest in the forenoon. Gates (50, 52) substantiated Winch's results, and Laird (79) extended them to conclude that the performance reaches its low point about 10:00 P.M., when there is an "end spurt."

Though the causes of such variation are not clear, the implication for clinical psychologists is clear. In order for the subject to perform in his best possible manner, the test should be made in the forenoon.

(7) *The Attitude of the Subject.* Since the attitude of the subject is another important factor ordinarily within the control of the experienced examiner, it too is listed here as an extrinsic factor. Too many excellent chapters have been written on the technique of establishing rapport with the subject for the present writer to go into detail. For such a discussion, the reader is referred to almost any current text on intelligence testing.

It will be sufficient to mention work in which the attitude of the subject has been found to have a definite effect on the memory span attained. Bronner, Healy, Lowe, and Shimberg (19) and Hao (57) report that the personal attitude of the subject definitely affects results, and Squire (121) found the use of pictures effective in testing the memory span of children, for it increased their interest.

(8) *Distraction.* Naturally enough, one would expect that the greater the distraction present in the situation, the poorer would be the performance of the individual, and this is actually the case (92, 117, 134). The reason for this effect is apparent. Inasmuch as attention is one of the processes involved in the successful functioning of memory span, if the processes of attention are directed towards some other stimulus, they cannot operate effectively in the memory span function. Distractions must be kept at a minimum for reliable results, as Lumley and Calhoon (82) indicate.

(9) *Practice.* Practice on the part of the individual is another extrinsic factor affecting the apparent length of the memory span. Although it is now commonly assumed that the memory span is a congenital ability (65, 116), investigations reveal that a temporary increase in memory span score will result from practice.

Gundlach, Rothschild and Young (56) and Ide (67) found that some individuals' memory span scores were increased, those of others not visibly affected by practice. Winch (137) and T. L. Bolton (16) reported marked improvement with practice on the part of their subjects. Foster (43), experimenting with 6 different materials, stated that there was a definite practice effect in his subjects, but that the gain was specific, and limited to the particular type of material used. This is probably further evidence that memory span is not a general ability, but is specific for different types of material.

The greatest practice effects on memory span thus far have been demonstrated by Martin and Fernberger (85), who discovered that the memory span of one individual increased 47%, that of another 36%, after periods of practice spread over several months. Foster's (43) subjects gained from 6% to 44%.

Dallenbach (35) and Gates (54) were interested in determining the permanence of the practice effect reported. Dallenbach, after training subjects for a period of 17 weeks, observed a practice effect 41 weeks after the drill had been discontinued. Gates trained a group of subjects over a period of 78 days (spread over 5 months) and at the end of training, this group had raised its average memory span by 2 digits. After 4½ months of no practice, the group had fallen back to its original average.

Reed (108), however, claims that practice effects are negligible, and Whipple (134) experimentally found that if adaptation and assimilative devices are held constant, there is no practice effect. We must conclude, nevertheless, that practice does have an effect on memory span score as it is now commonly obtained by experimental or clinical methods. The reasons again are fairly obvious, and are so well discussed by Foster (43) that a detailed discussion is unnecessary. Foster believes gains to be due to (1) confidence and effort, (2) familiarity with the material, (3) learning to distribute the attention effectively, and (4) efficient methods of work and organized procedure.

(10) *Subjective Grouping of the Units in the Series.* It has already been noted that presenting the units in the series of stimuli by any method of grouping or rhythm will enable the subject to secure a higher memory span than he would otherwise have. Often the subject himself is entirely responsible for grouping the units, and may thus increase his apparent memory span. In Martin and Fernberger's study (85) it was noted that any memory span over 5 was secured through subjective grouping of the units. Oberly (98) found that the memory span limen, as indicated by grouping on the part of the subjects, was from 6 to 13.8 units.

It is certain that subjective grouping will increase the memory span of the individual and thus contribute to the unreliability of the method. The many cases of unusual immediate memory are probably explained by such grouping, though in the case of some individuals, this grouping is merely a matter of associating some of the units in the series with others.

F. D. Mitchell's report of Inaudi (91; also reported by Binet, 8), who correctly repeated 42 digits on one occasion, and his report of the blind Swiss



who repeated 150 digits, are of this order. Even the famous Dr. Finkelstein, who appeared on Ripley's "Believe It or Not" program (111) could not have repeated the 15 digits he did on that occasion except through some method of grouping or meaningful association.

(11) *Temporary Pathological Condition of the Individual.* Some temporary pathological conditions of the individual will detrimentally affect memory span score. If the pathological condition is a permanent one, it may then be classed as an intrinsic factor, beyond the control of the examiner.

Kohnsky (76), controlling practice effects, found that pupils, several months after having dental treatment, increased their memory span scores. Paulsen (99) found, after equalizing for practice effects, that subjects who had been suffering from intestinal toxemia increased their memory span scores after treatment for the condition. These results, though apparently definite, need confirmation before final conclusions can be drawn. If the results are confirmed, we are probably justified in assuming that such temporary states have some adverse effect on the processes involved in memory span, making them less efficient. Another temporary pathological condition of the individual is that of hypnosis. P. C. Young (146) found no differences in "digit span" or "memory span" under hypnosis from that in the waking state, but his terms are not well defined and his conclusions thus have little significance.

(12) *Effect of Drugs.* Drugs may also produce a temporary condition which will affect memory span results. Since drugs produce a toxic state, the condition could well be included under the previous heading. Froeberg (45) and Hull (62) found a loss in memory span performance in non-smokers after smoking. Hull found that the habitual smokers showed a very small loss in efficiency due to smoking. From these facts Hull decided that habituation appeared to have produced a partial tolerance for tobacco with regard to its effect on the memory span. The explanation of the effect of drugs on memory span is obvious. The toxic states produced adversely affect mental processes, and through so doing, decrease the memory span score attained.

### *B. Intrinsic Factors*

In addition to the factors here called "extrinsic" (but only extrinsic in that they are largely within the control of the examiner, and if not properly controlled, tend to produce an erroneous memory span), there are also certain "intrinsic" factors affecting memory span. It is these in which the psychologist is primarily interested. These intrinsic factors are those within the individual which work to produce his "true" or permanent memory span.

(1) *Age of the Individual.* The age of the individual is a factor which definitely affects memory span.

Memory span has been found to increase with age by a number of investigators (8, 19, 27, 38, 40, 42, 56, 63, 69, 80, 121, 137). Norms for various age levels have been secured by McCaulley (86), Lumley and Calhoun (82), M. Murphy (95), Starr (123), Smedley (116), and Terman (126, 127).

It should be pointed out that if the mental age of the individual does not increase, the memory span will not. So far as is known, memory span increases along with intelligence up to a similar age.

At what age does memory span cease to develop?

Carpenter (27), in using subjects from 6 to 14 years of age, reported a consistent improvement from year to year. Fischler and Albert (42) found an increase of memory span to adulthood. Kuhlmann (78) claimed that memory span increased up to maturity, but neither Fischler and Albert nor Kuhlmann interpret their terms. Wesley (135, p. 176) found that the maximal memory span occurred at the age of 12 to 14, while Smedley (116) and Chambers (31), although finding a general increase with age, found no particular age at which memory span was maximal. Bourdon (18) reported that maximal efficiency occurred at the age of 14. Hao (57) placed the age at 13 or 14 for girls, 15 or 16 for boys.

A few investigators claim that memory span increases to a point somewhere between the sixteen- and twenty-six-year level, though a large number of workers believe that memory span remains constant after the individual reaches a point somewhere between 12 and 16 years. Once again, the investigators have used such diverse methods of administration and scoring, and such different material, that the results are scarcely comparable. It is not surprising that no definite conclusion can be reached regarding this and other points in question.

(2) *Sex of the Individual.* Sex may be another intrinsic factor affecting the memory span; there is some disagreement on this point.

Burt (22), T. L. Bolton (16), Gates (51, 52), Kirkpatrick (75), and Woolley (140) all reported consistent superiority of the females in memory span tests. Gundlach and his coworkers (56), testing memory span with flashing lights, observed only a very slight superiority of the females over the males. Lodge and Jackson (81) and Travis (128), however, using prose passages to test memory span, report the superiority of females over males.

No significant sex differences in memory span have been observed in children of kindergarten age (67), at the six-year level (38), in primary school children (30, 137), and in children in general below the age of 15 (31). Fischler and Albert (42), testing for audito span with digits, consonants, and phrases as material, and for visual span with forms and pictures, found no significant sex differences, either in children or in adults.

Adams (3) reported a slight superiority of men over women in forward memory span for digits, presented by the audito-vocal method. Chambers (31) noted a superiority of males over females above the age of 15, and Watkins (133) reported a superiority of boys over girls in memory span ability. Dallenbach (35, 36) found that when mental age was held constant, males consistently surpassed females in "visual apprehension."

Thus we can reach no conclusion as to the rôle of sex in memory span. All we can do at this time is to note that sex may be a factor. Again, the methods used are so different that results vary.

(3) *Race of the Individual.* Recent investigations indicate that the race of the individual is another factor which may affect memory span. Apparently the Chinese are superior to the whites, who may be in turn superior to the Negroes. Data concerning the memory span of other racial groups have not yet been reported. Hao (57), and Pyle (106) observed that Chinese children were superior to white children in immediate memory. Pyle (105) also found that negro children were definitely inferior to white children in rote memory. Clark (33), however, observed his negro subjects to be superior to the whites. The results here are purely exploratory, and need further confirmation, but at least there is some evidence that there are race differences in memory span.

(4) *Permanent Pathological Condition of the Individual.* When the physical condition of the individual becomes permanently modified, the memory span has been found to be lower than that for a normal individual.

Epilepsy is such a condition; W. G. Smith (117), as early as 1905, reported the inferiority of a group of epileptic subjects to normal subjects in memory span, while Ninde (97) substantiated this conclusion with a study of 2,000 epileptics.

Smith (119) also reported, in another article, that normal subjects were definitely superior in memory span to those in a pathological (insane) group. Pintner and Paterson (102) found that deaf children, as a group, had abnormally poor memory spans. They concluded that this was due to the lack of auditory experience. Bond and Dearborn (17), testing auditory "memory" for different types of material, reported that normal subjects were distinctly superior to the blind subjects they tested from the Perkins Institution. But Hayes (58) failed to substantiate this report when it was found that the blind subjects were superior to normal individuals in memory for auditory digits, but that for other types of material and methods of presentation, superiority of the blind or the normal group varied with the age group tested.

Apparently a pathological condition of the individual may operate to improve memory span; at least certain pathological cases demonstrate unusual memory spans, whether or not this is due to the

pathological condition. Barr (4) discusses Kitri, an "idiot savant" with echolalia, who repeated, after the first hearing, words and accents correctly in English, French, German, Spanish, Italian, Japanese, Latin, Greek, and Norwegian. Tredgold (129) tells of an imbecile who could repeat verbatim a newspaper he had just read.

These cases are not demonstrations of "true" memory span, for the individuals apparently reproduce the materials through some form of a memorial image.

#### V. CORRELATION OF MEMORY SPAN AND INTELLIGENCE AND WHAT IT MEANS FOR THE MEMORY SPAN AS A CLINICAL TEST

(1) *Relation Between Forward Memory Span and Intelligence.* Earliest observations of the relation between memory span and intelligence were made by Jacobs (69), who noted that pupils who stood high in class tended to have high memory spans, while Smedley (116) corroborated this report. Early experiments with feebleminded individuals pointed to the same fact—that memory span was directly related to intelligence (48, 72).

Early estimates of intelligence placed those with high memory spans near the head of the list (18, 22, 78, 137). Later investigators on the subject made use of the correlation coefficient and more objective measures of intelligence. Table II summarizes the coefficients secured between memory span and intelligence by various investigators using different types of forward memory span.

TABLE II  
CORRELATIONS REPORTED BETWEEN MEMORY SPAN AND INTELLIGENCE

Investigator	<i>Auditory Presentation</i>			
	Digits	Sentences	Commissions	Nouns
Abelson (2) <sup>†</sup> .....		.45, .18	.53, .65	.18, .19
Clark (33).....	.03			
Garrett (49).....	.21			
Wissler (139) <sup>§</sup> .....	.16			
	<i>Visual Presentation</i>			
	Digits	Letter Square	Nonsense	Syllables
Garrett (49).....	.18			
Wyatt (141).....		.18		.59

<sup>†</sup> Abelson's first figure represents results with girls, the second figure his results with boys.

<sup>§</sup> Wissler correlated auditory memory for digits with class standing rather than with intelligence.



This table shows that there is some relation between memory span and intelligence, and other results further indicate this relationship.

A contrast of results, probably reflecting differences between the 2 sets of subjects in intelligence, are those of Terman (126) and McCaulley (86). Terman sets the audito-vocal memory span for the normal six-year-old at 5 digits, whereas the backward children tested by McCaulley secured a modal span of only 4 digits. Starr (123) reported that the retarded, sub-normal, and low defective children all tested below normal in memory span. Squire (121) also found retarded children to be inferior in memory span. Bingham (13) and Humpstone (63) found that college students in general had higher memory spans than average adults, as tested by other investigators.

All of these findings indicate a definite relation between memory span and intelligence. But at the present time, results are so varying in nature that the true degree of correlation between the two is impossible to predict. Terman, both in his original revision of the Binet Test (126) and in his recent revision (127) feels certain enough of the high degree of relationship to include memory span tests throughout the scale.

(2) *Relation Between Reverse Memory Span and Intelligence.* Bobertag (14), in 1911, was the first to suggest the reverse memory span test. Little work has been done up to the present time in making use of the reverse span, except for placement in the 2 Stanford revisions of the Binet Test (126, 127). Fry (46) has been the only worker to run correlations between the reverse memory span and intelligence. He secured a coefficient of .75 for reverse audito-vocal digit span and intelligence (as measured by Army Alpha). This is higher than any correlation secured between forward span and intelligence.

(3) *Value of the Memory Span Test as a Diagnostic Measure.* The results of a memory span test, then, are ordinarily indicative of the level of intelligence of an individual. Binet and Henri (10), A. M. Jones (73), Ninde (97), Leaming (80), and others place memory span ability at the base of all intellection. Starr (123) states that memory span "expresses the index of proficiency of all the mental competencies involved." Ninde says, "It goes without saying that a certain degree of associability is essential to all intelligent behavior and it is of special value in the development of the intellect" (97).

Most research and clinical workers agree that the value of the memory span test lies in its clear differentiation of the upper and lower groups of the distribution (Brotmarkle, 20; Starr, 123;

Chambers, 32). There is too much overlapping at the middle and at the extreme upper end of the distribution of age and diagnosis. Most clinical workers place more value in low spans than in high spans. Opinions of clinicians in regard to "critical spans" are of interest. In the forward memory span, a normal child of 5 or 6 should have a span of 2 or more (Easby-Grave, 38). A forward span of 5 is taken as a prerequisite to do high school work, while an even higher span is probably a prerequisite to do more advanced work (Leaming, 80). Other "critical spans" are listed by Sherman (114), Ninde (97), and McCaulley (86).

The memory span test as an indication of the individual's intelligence has several clinical advantages. Ninde (97) points out that it is simple and easy to administer. It does not place an emphasis on language ability, nor is it a long, extended test which is apt to tire the individual. Witmer believes that it is one of the most significant clinical tests, and Starr (122) states that "it is without doubt one of the most valuable tests employed for diagnostic purposes."

But its very simplicity is one of the dangers of the memory span test. The inexperienced examiner is apt not to follow specifically the particular directions which he is using. In addition, the scoring must be done precisely according to the method used in securing the norms which the worker is using. There are so many additional extrinsic factors affecting memory span that if careful clinical conditions are not observed, the results may be meaningless.

Another danger is that the investigator may place too much significance on the memory span test. Bronner, Healy, Lowe, and Shimberg (19) think that the importance of the memory span test has been greatly overemphasized. Of course a memory span test alone should never be used for diagnosis; the results on the memory span test are merely suggestive, and should always be supplemented by other test results and by qualitative observation.

## VI. SUMMARY

Though 146 references are listed in the bibliography, it is appalling to note how little real knowledge there is in the field of memory span. Practically all of the questions raised in the present paper have to remain unanswered; many researches have been undertaken, but few facts have been proved.

It has been pointed out throughout the paper that the primary causes for this state of affairs are the widely diverse methods of administering the test, the many kinds of materials used, the different

groups of subjects used, the methods of scoring, etc. The question of whether or not memory span is a specific ability is essential; the effect of other factors cannot be answered until this is determined. For if memory span is a specific ability, it seems obvious that investigators using different materials and methods can expect only to get different answers to the same questions.

Probably the one thing most experimenters do agree on is a functional definition of memory span. But for other questions there are all sorts of answers. We do not know whether memory span is a specific or a general trait. We are sure that memory span is affected by certain extrinsic and by certain intrinsic factors, but we are not sure just what to include under each list, since all sorts of results have been claimed for any one variable.

Oddly enough, however, the test has been shown to have a fairly high reliability, and clinical investigators think enough of it seldom to omit it in an examination. It is favored by clinical investigators because of its close relation to intelligence (which has been fairly definitely shown), its simplicity, its brevity, and its lack of emphasis on language ability.

But, nevertheless, the whole field is wide open for a real experimental attack, for there is not a single aspect of the subject which is a closed chapter.

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## THE NEW STATUS OF EXPERIMENTAL STUDIES ON THE RELATIONSHIP OF FEELING TO MEMORY

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The significance of the psychoanalytic principle that pleasant memories tend to persevere, while unpleasant ones are 'censored' and repressed, requires no elaboration here. The experimental psychologist has been interested chiefly in the question whether this principle is true or not, and the investigation of this problem has engaged his attention since 1898. A rather thorough-going review and analysis by Meltzer (11), published in 1930 and covering all of the experimental work through 1929, showed that the experiments purporting to test this principle were in general so faulty in technique or logic that no solution as to the validity of the hypothesis was afforded by the ostensible evidence presented. Even Beebe-Center (2), summarizing the work on pleasantness and unpleasantness two years later, had to point out numerous discrepancies in the investigations of the problem in the field of memory.

Since 1929, however, the experimental studies on the relationship of feeling to memory have been so well controlled and the majority in such close agreement, that it is now possible to survey the work with a more encouraging view toward drawing definite general conclusions from the results presented.<sup>1</sup> For the sake of the completeness as well as the continuity of the review of experimentation on this subject, we shall follow through with the table of analysis adopted by Meltzer.

The table is more or less self-explanatory. The + or - sign which precedes the entry under 'Conclusions—Results' indicates the affirmation or contradiction of the main hypothesis, viz. the *hedonistic selectivity* in memory. The abbreviations P, U, and I stand for pleasant, unpleasant, and indifferent material respectively. Since most of the experiments are free of serious fallacies, the 'Remarks' are confined for the most part to differences in interpretation or

<sup>1</sup> E. H. Moore, in "A Note on the Recall of the Pleasant vs. the Unpleasant," *Psychol. Rev.*, 1935, 42, 214-215, refers briefly to the first few experiments since 1929. Several of the investigators listed in the present survey also review the work prior to their respective experiments. Cason's monograph (5) is the most thorough.

stress, and in some instances are omitted entirely. The experiments are listed in chronological order, and the numbers in parentheses correspond to the numbers of the references in the bibliography.

It will be noted that the fallacies pointed out by Meltzer in the earlier studies are virtually absent from those considered here. Only one makes illegitimate use of the questionnaire. No one has committed the naïve error of simply asking subjects to recall experiences from a given period, and counting them on the tacit assumption that the original experiences were equally divided between pleasant and unpleasant. None of the recent studies can be accused of using too few subjects to be of any value. Although 7 of the earlier studies used as few as 5 to 12 subjects, the range of subjects in all recent studies has been from 15 to 1080, not counting the invalidated questionnaire study, which had over 2000. The general approach of the investigators has also been apparently more unbiased. No one showed any serious predisposition to discredit psychoanalysis on the one hand, or to champion the Freudian cause on the other—prejudices which were unfortunately all too obvious in some of the earlier works. The affective tone of the material used has also been determined more or less objectively, from the experimenters' point of view, in all cases save that of the questionnaire experiment previously referred to.

Our criticisms are thus chiefly confined to 3 considerations gleaned from the experiments themselves, which tend to reconcile the negative results:

(1) *Use of Immediate Recall to Test Hypothesis.* Drawing general conclusions about memory from the special case of immediate recall is obviously the fallacy of the undistributed middle term to begin with. Furthermore, the theory of repression of unpleasant memories is never applied to immediate recall. Several experiments giving data on both immediate and delayed recall show that while the former yields negative or ambiguous results, the latter is generally positive.

(2) *Age of Subjects.* A study by the present author (7) shows the need of controlling this factor, since children do not show any consistent selection of affectively-toned material, while adults do, under the same conditions. Examination of other experiments reveals similar results.

(3) *Unequal Affective Decrement of Recalled Experiences.* Although recalled experiences are closest to the 'real life situation,' that elusive goal of the experimental psychologist, they present one

Investigator and Date	Subjects	Method	Conclusions—Results	Remarks
Koch, H. L. 1930 (9)	76 college students	Recall of grades on 10 true-false quizzes, 5 weeks after students receive them and rate them for affective reaction.	Grades recalled in order of P-U-I.	As experimenter points out, numerous incidental factors determine reaction to grades in different students.
Thomson, R. H. 1930 (19)	30 high school freshmen for tests 1-5; 100 higher classmen for 3, 4, 6	<ol style="list-style-type: none"> <li>1. Recollections of early childhood.</li> <li>2. Recollections of grammar school experiences.</li> <li>3. Keeping diary records with recall after 2 and 4 weeks.</li> <li>4. Word lists—writing 20 P and 20 U words, and recalling after 1 month.</li> <li>5. Recalling titles of P and U poems.</li> <li>6. Evaluating current events as P and U, recall after one month.</li> </ol>	<p>All tests in larger group show distinct and reliable differences in favor of P; in smaller group, tests 2, 4, 5 show reliable difference in same direction; tests 3 and 4, taken by both groups, show greater and more reliable difference with larger group.</p> <p>Test 4 (word lists) considered best controlled for original division of P and U, subjective evaluation by subjects, and 'vitalness.' This test also found most reliable in terms of <math>D/\sigma_0</math>; note that larger (older) group shows more pronounced hedonistic selectivity.</p>	
Meltzer, H. 1931 (12)	132 college students	Description and evaluation of experiences during Christmas vacation, recall 6 weeks later.	Greater per cent of original U than P forgotten; correlation with intelligence negligible.	
Frank, J. D., and Ludvigh, E. J. 1931 (6)	15 college students	Learned paired nonsense syllables followed by stimulation by P and U odors, then recall.	Efficiency of recall in order of P-I-U; fair correlation between P-U potency and recall.	



Investigator and Date	Subjects	Method	Conclusions—Results	Remarks
Jersild, A. 1931 (8)	51 college students	Recording P and U experiences of preceding 3 weeks, and recall after lapse of 3 weeks.	+ Reliably greater per cent of P experiences remembered.	Unequal affective decrement handicaps P; proper allowance would therefore increase P advantage.
Stagner, R. 1933 (16)	150 college students	Writing associations of 1 P and 1 U experience of each S, recall after 3 weeks.	+ Greater per cent of associations with P than with U recalled.	
Cason, H. 1932 (5)	1. 90 college students 2. 27 college students 3. 50 college students 4. 74 college students	1. Recall and grading of incidents occurring 3 days prior to test, and regrading 3 weeks later. 2. 120 paired associates of P, U, and I words; tested for immediate recall, and 1 day and 16 days delayed recall. 3. Paired associates of P, U, and I words. 4. Recalling and grading experiences for affective value, time elapsed, and frequency of recall since occurrence.	Tests 1 and 4 yield negative results. + Tests 2 and 3 yield slight positive P selectivity.	Although negative results of tests (1 and 4) using experiences might be accounted for on basis of unequal affective decrement, author stresses negative results and minimizes positive results of tests (2 and 3) using words.
Lynch, C. A. 1932 (10)	1,080 college students	Cards with P, U, and I words exposed, and subjects tested for immediate recall and recognition; retested after 1 and 3 weeks.	No appreciable difference in immediate recall. (+ Difference evident in delayed recall.)	Author does not support 'bi-directional' effect of emotional influence on recall, although his experiment was not controlled with that end in view; examination of the rank-order data in delayed recall does support it, however.

Investigator and Date	Subjects	Method	Conclusions—Results	Remarks
Stagner, R. 1933 (17)	200 college students	After evaluating list of words + for affective value, group was given 150 sec. to memorize, and tested for immediate recall.	Words recalled in order of P-U-I; fair correlation between memory value and P-U potency.	Immediate recall not a good test of hedonistic selectivity.
Balken, E. R. 1933 (1)	20 college students	Exposing list of words and testing for immediate recall.	No significant difference between P and U words.	Immediate recall not a good test of hedonistic selectivity.
Bunch, M. E., and Wientge, E. 1933 (3)	125 college students	Each of 3 groups learned P, U, + and I material respectively; half of each group then learned I material, other half none; then all tested for recall.	Order of learning P-I-U; recall P-U-I.	Combination of PGR and subjective rating for each S best criterion used thus far to determine P and U value of material.
Rosenzweig, S., and Mason, G. 1934 (14)	40 children 5½–14½ years of age	Jig-saw puzzle contest arranged so that each subject succeeded in only half of puzzles attempted; subjects tested immediately for recall of names of puzzles, rating of affective reaction, and success estimate.	No significant difference in group recall of P and U puzzles, but individual P-preference function of M.A. and pride rating of subjects to slight degree.	Immediate recall not a good test of hedonistic selectivity, and using only children as subjects also limits conclusion.
Silverman, A., and Cason, H. 1934 (15)	75 college students	4 lists of 117 words evaluated + for P-U-I and tested for recall and recognition at 5 min. intervals.	Order of recall and recognition P-U-I.	

Investigator and Date	Subjects	Method	Conclusions—Results	Remarks
White, M. M., and Ratliff, M. Mc. 1934 (21)	1. 42 college students	1. Memorizing list of 10 P, 10 I, and 10 U words; recall after 1 and 2 weeks.	+ More P than U words recalled on all tests, difference becoming greater with increase in time interval before recall.	Test 3 uses immediate recall and shows poorest results.
	2. 25 college students	2. Same list memorized by 4 other groups, divided for 1, 2, 3, and 4 weeks recall, respectively.		
	3. 239 college students	3. List of 5 P, 5 U, and 5 I words read to subjects; test for immediate recall.		
Menzies, R. 1935 (13)	50 college students	Students wrote experiences of previous day, evaluating affective quality and degree; tested for recall and re-evaluation after 1 week and 3 weeks.	— Recall correlated with intensity of feeling tone rather than quality.	As author's figures show, negative results can be attributed to unequal affective decrement of recalled experiences.
Susukita, T. 1935 (18)	2,051 Japanese primary school children	Questionnaire asking subjects whether certain memories were more vivid than others (types of memories listed and evaluated by experimenter).	— 'Memory pessimism' increases with age.	Questionnaire invalid and only children used as subjects.
Carter, H. D. 1936 (4)	100 children in sixth and seventh grade at beginning of experiment	Learned P, U, and I paired associates, rated for affective quality and degree by subjects; tested for recall over period of 2 years.	+ Efficiency of recall in order of P-U-I; difference becomes more reliable as mass of data is increased; P advantage slight.	Children used, but these are presumably 13-14 years old at conclusion.

Investigator and Date	Subjects	Method	Conclusions—Results	Remarks
White, M. M. 1936 (22)	1. 8 adults  2. 123 adults	1. Learned list of 10 P, 10 U, + 10 I words; recall groups for 1, 8, 15, 29, 43 days.  2. Words read aloud and subjects wrote words associated with each stimulus word in 30 sec. limit.	Superiority of P becomes more and more pronounced with increase of time interval.  P has more associated words and that may explain superiority of P in recall.	Cf. White and Ratliff (21), and Carter (4).  Greater number of words associated with P may indicate better memory for P-associations or simply greater vocabulary of P words associated with words learned.
Waters, R. H., and Leeper, R. 1936 (20)	245 college students	Subjects wrote and rated experiences of previous Christmas vacation; divided into groups for recall after 2, 4, 7, 14, 28, 49, 70, and 140 days.	? "Slight trend toward better retention of P in all categories," but retentivity function of degree rather than quality of affective rating.	Unequal affective decrements may account for "slightness" of trend.
Gilbert, G. M. 1937 (7)	20 fourth grade children and 20 adults	Subjects learned list containing 5 P and 5 U words; tested for recall and affective potency of words 1 week later.	Adults showed P preference in delayed recall; children did not show it at all; affective potency shown more important factor than affective quality in immediate recall.	



serious difficulty in this type of experiment. As most of the investigators using this type of material report, recalled experiences become less and less pleasant or unpleasant with an increase in the time elapsed before recall. The affective tone may even be reversed in retrospect, but whether the change is one of reversal or progressive indifference, *unpleasant* experiences suffer more thereby than do the pleasant ones. Since this fact itself tends to support the hedonistic hypothesis, it cannot be used to disprove the hypothesis by the artifact that more of the originally unpleasant experiences are sometimes recalled, or that the difference is negligible.

Of the 20 experiments published since 1929, 13 support the hypothesis of hedonistic selectivity in memory, 4 deny it, and 3 give ambiguous results. If all the experiments subject to the above criticisms are ruled out, however, and the hypothesis correspondingly modified, the score becomes 11 pro and 0 con.

*General Conclusions.* The preponderance of evidence yielded by the experimental studies on the relationship of feeling to memory from 1930 to 1937 inclusive justifies the following general conclusions:

(1) Pleasant material, in general, is more efficiently retained than unpleasant material, as tested by delayed recall, although this difference is often slight.

(2) The vividness or 'affective potency' of the material is an important factor in recall, but is more so in immediate than in delayed recall, as compared with the hedonistic factor.

(3) Hedonistic selectivity, even in delayed recall, is less pronounced, or absent, in children.

(4) The affective tone of recalled experiences usually progresses toward neutrality or indifference as time goes on, but unpleasant experiences tend to suffer more in this respect, and become neutral or pleasant more often than pleasant experiences become indifferent or unpleasant.

(5) The superior retentivity of pleasant material becomes more pronounced as the time interval increases, but may eventually decrease due to approaching the asymptote of complete forgetting of both kinds of material.

Finally, although all of the above conclusions are still subject to further verification, we may point out some of the questions which have not as yet been answered, and are still open leads for future investigation:

(a) What individual differences, such as sex, introversion-extroversion, intelligence, social status, etc., are correlated with the

tendency of some individuals to forget the unpleasant more than others?

(b) Can age differences be demonstrated on the physical level, or is it confined to verbal memory?

(c) Is this tendency normal and protective or a psychopathic tendency? Experiments comparing normals and abnormals should prove fruitful.

(d) Is unpleasant material so actively repressed that it is not recalled as easily as indifferent material, or does this hold only under certain conditions, if at all?

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## BOOK REVIEWS

KELLER, F. S., *The Definition of Psychology*. New York: D. Appleton-Century Company, 1937. Pp. vi+111.

It is no easy undertaking to present the problems of systematic psychology in a way that enables the college student to see what, if anything, it is all about. But Dr. Keller has succeeded in doing this. The small volume is really a brief survey, using the method of the sample, of the main contentions of structuralism, functionalism, behaviorism and Gestalt psychology.

There is an introductory chapter on the beginnings of psychology, and a concluding one presenting some of the conclusions or tentative suggestions developing out of the survey. Naturally there is no room for details. Some contributions of Descartes, Locke, Berkeley, Hume, the Mills and Fechner serve as selected keys to the early development of psychological issues after the time of Aristotle.

Wundt is given a short chapter and then Titchener's accounts in the *Textbook* and the *Beginner's* are made the basis of a neatly summarized survey of structuralist ideas. Even the introductory student is made to feel the paradoxes of Titchener's story. There is for example the "physical world" which is to contain no nervous system, whereupon the nervous system and its forces, obviously in some world or other, are introduced. Even the paradox about meaning being context, then being carried by context, and then being there even when there is no context, stands out like a sore thumb.

The chapter on functionalism shows clearly enough that there never was such a system of psychology, but instead mainly a group of unrelated expostulations. The brief survey reveals how difficult it is to find anything except a vague attitude as characteristic of this movement in American psychology.

Watson's account and program is used to bring out the main points of the behaviorist outlook, and it is here that the method of the sample most clearly fails to exhibit the full import of a viewpoint. But so far as topics are concerned, enough points are concisely presented so that the beginner should easily get the feel of the behaviorist's fervor.

The "subtle charm and dramatic qualities" of the Gestalt principles are brought out chiefly by references to Wertheimer's "appar-



ent movement" and to various topics from Koffka's text. In the concluding sections there are indicated some of the outstanding characteristics of contemporary American psychology. Various similarities between the "schools" are suggested to show how much differences in terminology add to the arguments, and to indicate a probable drift toward a more coherent eclectic viewpoint than that now often resorted to.

The author writes pithily and clearly. The account is confessedly sketchy, and men rather than ideas are featured in the interests of animation and brevity. It is a useful volume, and nicely supplements Garrett's *Great Experiments* as collateral reading for introductory students who really want to know something about the problems of psychology.

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KLEIN, DAVID BALLIN, *General Psychology*. New York: Henry Holt and Company, 1936. Pp. xiv+560.

The evaluation of any book depends upon the purpose for which it was written. This book was written to satisfy the demands of three groups of students: "(1) a larger group whose members will never take another course in the subject and who consequently desire a general, cultural orientation in the field; (2) a smaller group made up of students who require a background in psychology to facilitate their work in cognate subjects, particularly the social sciences; and (3) a very small group of those who plan to major in psychology either academically or professionally" (v).

The author begins conventionally enough with a discussion of the nature of psychology, but fears that the student will be confused by a series of definitions. Illustrations of the psychological content of familiar situations are substituted for formal definitions. Since, however, psychology is a science, he considers the scientific attitude as contrasted with other attitudes, such as the aesthetic. Psychology is so complex a field that it may be approached in many ways, such as the structuralistic, the configurational, the behavioristic, the psycho-analytic, and others. An impartial, non-partisan exposition of the different schools follows.

Klein chooses to begin his own exposition with motivation and conation. This is followed by chapters on emotion, learning, thinking, perceiving, and individual differences. Conation and symbolism are the major themes about which much of the discussion revolves.

As a whole, the book shows evidences of wide reading and a philosophic background.

With the starting point which he has selected and the limited number of general topics included, the prospective reader will wonder whether the author has included a sufficient number of the sub-topics which compose the usual elementary text. In general, he has, though the emphasis is unconventional. For example, he devotes ten pages of small type to the receptors and seventy-eight pages to general orientation in the field. Practically no mention of the nervous system occurs, while one hundred pages are devoted to learning. At times a topic is included in a most unusual setting. Empathy is discussed in relation to space perception and association by identity, and association by similarity in relation to illusions.

While the discussion of thinking is involved and muddled, the ideas are in general clearly put and supported by convincing evidence or logic. Yet his discussion of the relation between the thalamus and emotion leaves something to be desired. Ambiguous or incorrect statements are rare. On page 40, for instance, he gives a figure "Illustrating how identity of parts may result in diversity of configurations." Yet the identity occurs only in pairs of figures. On page 457 he says, "To activate a receptor a stimulus must be of a minimum degree of strength," which is obviously untrue for supra-liminal stimuli. In connection with the graph on page 497, the reader will wonder why persons between 5' and 5' 1", between 5' 3" and 5' 4", . . . , between 6' 3" and 6' 4" are excluded from consideration.

The book will probably have the greatest appeal to those who plan to major in psychology, and to those interested in the social sciences, because of the emphasis on conation.

The reviewer got the impression throughout the book that the author was writing down to his readers.

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HOFMANN, PAUL, *Sinn und Geschichte*. München: Ernst Reinhardt, 1937. Pp. xv+712.

In this stout volume, the fruit of ten years' labor, Professor Paul Hofmann provides the answer to his own conviction that an entirely new foundation of philosophy is necessary if we are to understand the spirit of history. This new philosophy involves the search for

meaning, based upon the commonest, best known, most certain "fact," the secret of our consciousness of life. To that end Hofmann begins with a systematic introduction, relating meaning to philosophy and culture. Meaning, he contends, has no significance apart from experience, but at the same time culture is an expression of meaning. Having established these premises, he traces the loss of meaning from objectivism through ancient, medieval and early modern history. From this he returns to narrate the meaning of cognition and its history, the loss of meaning in positivism, Kant's failure to develop his philosophy of meaning to its logical extreme and the consequent loss of meaning in idealism, and the failure of voluntarism and irrationalism to solve the problem of meaning.

The second part of the volume follows logically in explaining the meaning of life as the problem of ethics. Here again Hofmann finds objectivism erroneous in its interpretations, for the ethical problem is to be understood only in meaningful self-examination. The same situation applies also in the problem of society, for the relationship between society and the individual is not to be understood as objective and one-sided. The individual and society are interrelated. This leads to an examination of the meaning of community and to an account of the development of community *ethos* throughout history. Despite various efforts and short-lived successes, this *ethos* has failed to reach its fullest realization due to faulty philosophy. This deficient philosophy consists in the failure of objectivism to supply a meaningful relationship between the ego and society.

Although frankly written to answer the need of these critical times for a "new" philosophy, the book appears to have no *direct* relation to contemporary German affairs. Because of its extremely abstract approach as well as its difficult style, the book strains the comprehension. Indeed, one is reminded of the comment by Ernest Barker concerning the work of Gierke, when he speaks of hearing the thunder roll and wondering what the thunder really says. Briefly stated, Hofmann's volume is a plea for a new subjectivism which starting with Kant's undeveloped hypothesis follows not the line of German idealism but that of social empiricism. Such a solution, says the author, alone will enable man to understand the true spirit of history.

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HOLMES, ROGER W., *The Idealism of Giovanni Gentile*. New York: The Macmillan Company, 1937. Pp. xvii+264.

This book, which psychologists will appreciate as an interesting exhibit of intellectual behavior, consists primarily of placing the *Nihil Obstat* upon Gentile's Actual Idealism. The author sits in pontifical judgment upon Gentile's *Sistema di Logica*, in which he finds five Errors, the clearing up of which gives actual idealism a clean bill of metaphysical health.

Actual idealism is Gentile's well-known superessential spiritualism in which the true Ego and objective Logos are revealed, as well as the really Real which natural science cannot even approach from a distance. Another of its characteristics is its supreme Solipsism, well indicated by a typical Gentilian passage which the author reprints not only once or twice, but three times. "Philosophy is always understood . . . as the most universal and perfect form of the Spirit, which understands all other forms without being understood by the others in return" (pp. 101, 122, 212).

In the twentieth century can such things be? Not only can they be, but they can be made to work. They work, for example, in Gentile's Fascistic Theory of the State, a theory which justifies the arduous disciplines (sic!) imposed upon individuals by declaring that however terrible they may be for particular persons they are nevertheless good for the sake of a super-individual spirituality.

The author is not unaware of the anomalies of actual idealism, since he refers to the neopositivistic criticism that it is meaningless verbiage. But he justifies his own acceptance of it by the value argument. Holmes says: "Empirical science can tell all we are able to know if we wish certain events to occur in the future." Psychology, for example, can tell us how to rear a child to a particular end. But the choice of that end involves ultimate values beyond the reach of science. Since, however, such choices must be made every day, because we must know what is good or valuable for children, our only resort is to spiritualism. This notion is in line with Gentile's argument that "the teacher is concerned with the development of the human spirit, not with the objective bodies or minds of men."

Mr. Holmes informs us that in addition to spending a half year studying with Gentile in Rome, he also viewed political and educational reforms. Probably the solution of the difficulties generally experienced in understanding these reforms lies in considering that they are really spiritual in character.

J. R. KANTOR.

*Indiana University.*



MARINESCO, G., and KREINDLER, A., *Des réflexes conditionelles*. Paris: Félix Alcan, 1935. Pp. vii+171.

This book is a reprint of three articles previously published in the *Journal de Psychologie* (1933, 30, 855-886; 1934, 31, 206-272, 722-791. See also *Psychol. Abst.*, 1934, 8, 2494, 4457; and 1935, 9, 3194). It brings together the results of studies of conditioned reflexes of human infants, children, and adults done at the Bucharest Hospital. Its expressed aim is to show the value of such studies for neuropsychiatry. Neurologists and psychiatrists will probably be little impressed by the extent of the contribution of this field to the clarification of their problems, but the book has considerable potential interest for students of the conditioned reflex. For the latter its contributions are two: a very interesting attempt to make consistent with conditioned reflex theory a wide range of experimental findings taken from psychology, neurophysiology, experimental embryology, anatomy, and endocrinology; and the suggestion of many problems for experimental study, especially on the characteristics of CR's in infants and children and in neuropsychiatric patients.

A ten-page introduction defines CR terms, strictly following Pavlov. Part I (67 pages) deals with the neurophysiological mechanisms of the CR. This part left the reviewer gasping at the range of facts which Marinesco and Kreindler find consistent with Pavlov's theories. Holding that the CR is the result of the formation of a connection between sensory and motor centers, they elucidate this process, or find analogies with it from the following: Tilney's phylogenetic studies of the brain, Coghill's developmental studies, Langworthy's myelogenetic studies, cytoarchitectonic studies of the cerebral cortex, Kappers' studies of neurobiotaxis, Child's studies of physiological gradients, studies of the relation of neural growth rates to endocrine functions, neurophysiological studies of excitation, refractory period, summation and inhibition, and their own studies of experimentally induced modifications of cortical chronaxies under conditions analogous to those of a CR experiment. The formation of a connection is attributed at various points in the discussion to changes in chronaxie, neurobiotaxis, and chemical factors at the synapse. This omnivorous ingestion of materials is accomplished with apparent ease, but some readers will be concerned over the possibility of their assimilation.

Part II (24 pages) presents experimental studies of CR's in infants and children between the ages of fourteen days and three and one-half years. Motor responses to shock on the hand or foot were

conditioned to a light or metronome whose action preceded the shock by thirty seconds. In the main their studies are an attempted duplication of the various CR phenomena described by Pavlov. "The study of conditioned reflexes of children shows, then, that, on the one hand, the laws experimentally established by Pavlov for the dog are verified in man, and, on the other hand, that cerebral dynamics in man are more perfected and complicated than in the animal as a consequence of the perfection and complication of the laws which rule conditioned reflex in man" (p. 93). Implications of the CR for education are freely discussed, and the suggestion made that educational principles should be revised in the light of CR principles.

Part III (70 pages) concerns the application of CR's to neuropsychiatric clinical problems. It describes and discusses the significance of numerous studies of patients done mainly by the methods of motor and vasomotor CR's based on response to shock. They conclude from data on 6 pyknics, 4 asthenics, 3 athletics and 3 asthenic-athletics, of ages 18 to 51, that the results show "... no exact relationship between the rate of conditioning and constitutional type . . . [but], . . . that the ability to inhibit a conditioned reflex is specific to the constitutional type" (pp. 106-108). From CR experiments on the aged they conclude, "Reasoning and judgment are defective because trace reflexes are not easily set up. These reflexes are, in effect, the basis of the syllogism" (p. 112). Their findings are believed to indicate that the neuroses are possibly due to an abnormally easy acquisition of CR's and backward CR's. Of the delusions of persecution of paranoia they say, "In normal man the center for the defense reaction is excited only by real danger. . . . In certain patients the excitability of this center is raised, and, on the basis of this unconditioned defense reflex there arise a long series of more complicated conditioned reflexes. In the first phase the reflex is still generalized, and no particular persecutor exists. Then the reflex concentrates itself, and is called forth only by certain objects" (pp. 149-150). Basic to their discussion of aphasia and stuttering appears to be the notion that speech is a chain CR in which each syllable leads to the next as a CR.

In the reviewer's opinion the virtues of this book are overbalanced by its defects. First among these is the uncritical application of Pavlov's theories of the cerebral mechanics of behavior to all aspects of behavior. The virtues of this procedure for the tentative organization of varied observations are no longer apparent when these theories, based on incomplete and sometimes inaccurate obser-

variations, are mistaken for facts. Such a bias can lead only to the unintentional distortion of newly observed phenomena. The second major class of defects pertains to their methodology. Sweeping generalizations are in most cases drawn from experiments with wholly inadequate numbers of subjects. This difficulty is aggravated by the heterogeneity of subjects within the experimental groups. A possible further limitation on the use of the data is present, since there is no indication that Marinesco and Kreindler are alert to the possibility of variable attitudinal factors in their subjects playing a role in the determination of results. If quantitative statements about rate of acquisition or rate of development of differentiation and about extent of generalization of CR's are to be made, it seems essential that the role of the general experimental situation and of the actions of the experimenter in instructing and handling the subject should be explicitly recognized as factors to be controlled, so that unsuspected sources of variability may not arise from variable initial attitudes of the subjects. Finally, the graphic records used as illustrations are not convincing evidences of good methodology. Either because of defects of the recording systems or because of retouching of the records for purposes of clarifying the illustrations, one is left in doubt as to which features of the records are artifacts and which represent the variations in the properties of the observed behavior systems.

G. R. WENDT.

*University of Pennsylvania.*

BINGHAM, WALTER VAN DYKE, *Aptitudes and Aptitude Testing*. New York: Harper and Brothers, 1937. Pp. ix+390.

This volume is addressed primarily to "those in or out of educational institutions whose concern it is to help inquirers intelligently to plan their training and their later occupational advancement." The critical reader will early be impressed by the thorough fashion in which the author sets out to accomplish this end and by his success in avoiding the Scylla of overenthusiasm and the Charybdis of despair and impatience. Throughout the volume, emphasis is placed upon aiding the individual to find himself; the counselor is portrayed as occupying the role of guide rather than that of the high priest unlocking the mysteries. The tenor of the exposition is that of the impartial investigator seeking to evaluate a method and not that of the ardent missionary who offers tests and scales as a panacea for all vocational ills.

The first major section of the book, entitled "Aptitudes and Guidance," shows aptitude measurement to be a measuring of present performance as symptomatic of potentiality and suitability, with predictions to be made only in terms of probability. Later chapters in this section are concerned with the nature of individual differences and with intelligence tests, interest tests, and achievement tests as measures of aptitude. Among the high points of the chapter may be mentioned the criticism of Thorndike's recent vocational survey, the careful discussion of the much-abused 'normal curve,' and the author's insistence on the stimulative value of vocational tests.

The second main section concerns itself with "Orientation Within the World of Work." After an introductory chapter, the author reviews a half-dozen major categories of occupations, beginning with manual occupations and concluding with the professions. In each case he attempts to present an objective view of the characteristics of each of a number of subcategories and to consider the outstanding specific tests which may be applicable. There is a pleasing absence of broad generalities and a genuine effort to exhibit the salient features of each type of work considered. Bingham repeatedly points to the necessity of discovering whether a candidate would prefer a high place in a 'lower' occupational group or a lower place in an occupation standing higher in social regard. This section should afford an excellent counterblast to the roseate views of occupations which have gained wide currency in certain treatises on guidance.

The concluding section of the volume is devoted to "The Practice of Testing." Here successive chapters deal with the selection, the administration, and the interpretation of tests, typical examples of which, together with norms and an appropriate bibliography, are provided in a generous appendix. The chapter on the selection of tests is noteworthy for its air of critical but sympathetic scrutiny, and for an excellent discussion of the characteristics of criteria to be used in validation. The chapter on administration of tests contains a stimulating section on observation of behavior in the test room as a necessary adjunct to adequate testing. The concluding chapter depicts a test score as a band rather than a point, and discusses means of reducing the width of this band.

Although Bingham has written in a field which has already a large bibliography, his contribution is no mere rehash of previously published material. He writes with clarity and with vigor in a field obviously known intimately at first hand. He speaks of the value of



small gains in accuracy of prediction and not in grandiose terms of a millenium already achieved. He contributes much that is original and he lays his finger on many a weak point in common methodology. As a result he has produced a volume which will be quite as valuable to psychologists in general as to the particular group for which the book was designed.

JOHN G. JENKINS.

*Cornell University.*

GUILLAUME, PAUL, *La psychologie de la forme*. Paris: Ernest Flammarion, 1937. Pp. 236.

Although the author has written his book chiefly for a French audience, the reviewer knows no other which he could recommend more highly to the American or any other reader interested in Gestalt psychology.

Guillaume tells the story of an idea: the soil it sprang from, its intensive and extensive growth, its impact on some of the prevailing fundamental psychological and philosophical concepts—these are his topics. In his book the achievements of Gestalt psychology do not appear as the result of individual ambitions and personal rivalries, but as the outcome of a rational process unfolding itself gradually in the actual theoretical and experimental work of research students. The reviewer may be a biased witness, but at least he is a witness, and as such he can testify to the historical truthfulness of this picture.

The organization of the book, following more or less conventional lines, is thoroughly adequate. The first chapter, on the origin of the Gestalt idea, gives a superb survey of the ideas among and against which the Gestalt concept was formed. The second chapter, physical Gestalten, gives a lucid account of Köhler's work on Gestalten in physics and physiology, an account as concise as it is relevant and adequate. The next two chapters give an excellent introduction to the psychology of perception, illustrated by selections from the most important experimental papers. The fifth chapter, ego and action, discusses the total field and its polarity, subjective attitudes, reflexes and instincts, the emotions and the will, and contains a section largely though not exclusively devoted to the work of Lewin and his school; a final section of this chapter gives a theoretical discussion of the consciousness of the relation between an action and its cause. A very short chapter on memory shows how Gestalt conceptions have not only influenced the theoretical interpretation of memory and its functions, but have also led to a new kind of experimental approach

in this field. The seventh chapter, on intelligence, treats in different sections the perception of relations, inventions by animals and children, and higher forms of intellectual invention. In four propositions the author summarizes at the end of the chapter what, according to Gestalt theory, intelligence is not, and what it is. The eighth chapter, expression, treats first the traditional, and then the Gestalt theory of expression; these expositions are followed by brief sections on the synesthesias, on individuality, and on imitation.

The final chapter is entitled "comparisons and discussions." Its first section, the philosophical position of Gestalt theory, is one of the most brilliant parts of the book. With admirable clarity and insight it answers the following questions: Is Gestalt theory spiritualism or materialism? Is it metaphysics or a positivistic philosophy? Is it a form of empiricism or of rationalism? Is it a psychology of consciousness or of behavior? In a second section a number of criticisms directed against Gestalt theory are discussed, and in a concluding section the author, rejecting the claim that Gestalt theory has done no more than introduce a new magic word, sums up by emphasizing once more the generality of the Gestalt concept and by charging the future with the task of submitting the Gestalt hypothesis to new tests and of developing it in ever new fields. "Gestalt theory has the incontestable merit of having raised new problems and of having traced a whole research programme which has proved to be fruitful and has steadily grown in scope." These are the concluding words of a book which anyone should read who is interested in the subject of psychology.

K. KOFFKA.

*Smith College.*

BEHANAN, K. T., *Yoga: A Scientific Evaluation*. New York: The Macmillan Company, 1937. Pp. xviii+270.

Yoga, which means "to yoke," "implies the claim that the practitioner of yoga will ultimately be able to unite his soul with the world soul." "A scientific evaluation" of this ambitious claim is the aim of the volume by Kovoov T. Behanan, as stated in the subtitle. The foreword, written by Professor Walter R. Miles, relates the author's birth in India, his graduation in 1923 from Calcutta University, and his more recent two years study of the yoga discipline in India. Promise is made that "a fascinating, educational experience is in store for those who read without preliminary prejudice or bias, either for or against yoga and its teachings."

Students of philosophy as well as readers with a penchant toward the occult and the mystical will enjoy the study, which is written in an easy semi-popular style. Yoga was one of the six classical systems of philosophy evolved from the upanishadic teachings. In the first seven chapters, the author outlines the cosmology and doctrines concerning evolution of mind and matter which were borrowed with minor modifications from another system, Samkhya. He gives accounts of the three *gunas* which are at the basis of the universe, and the *buddhi*, which is the basis of the empirical ego. Frequently with a certain boldness, he draws interesting comparisons with modern philosophies.

Most readers, particularly if psychologists or physiologists, doubtless will have "preliminary prejudice or bias" concerning a practice whose avowed purpose is "soul-union." Upon completion of a chapter entitled, "Rebirth," we are halfway through the volume and still await the presentation of anything like scientific evidence. The author writes, "Until we know more about what is at present partially a mystery, those who believe in rebirth would seem justified in seeking an explanation from the doctrine of transmigration for inequalities among men in respect to mental and moral capacity." The reader may wonder whether such comments as this can justifiably be included under the subtitle "Scientific Evaluation."

Yogins sometimes see apparitions, hear strange sounds, or smell fragrant odors which they for the most part know to be hallucinations. In a chapter entitled "Yoga and Psychic Research," the author comments, "If and when extra-sensory perception is established beyond any doubt, theoretical considerations would probably lead to a hypothesis not very different from the yogic theory."

In chapter ten, approximately three-quarters of the way through the volume, is the first description of yogic practice, namely the postures. Illustrative cuts are presented of the fish posture, the peacock posture, and others, including one in which the right nostril is closed in a precise correct way with the right hand. These illustrations cannot fail to interest and amuse American readers, although physicians might question the soundness and sanity of such practices.

According to the author, the postures and exercises, coupled with the breathing exercises, help the yogins to maintain their bodies at a high level of physical efficiency. However, he furnishes no scientific evidence to justify his statement.

In certain types of breathing (*pranayama*) the author believes that the "yogin finds that changes occur in his mental state; in a

marked way his awareness of the external world diminishes." The beginner is taught to inhale, to hold his breath, and to exhale in particular time relations. In one of the eight varieties of pranayama, the glottis is partially closed so that a sound like sobbing is heard. It is best to concentrate on that point in the nasal passages where the first touch of inhaled air is felt. All of the various types of breathing are stated to be conducive to the awakening of "spiritual forces." The author believes that it is justified to conclude that the holding period in such breathing "probably has important bearing on the physico-chemical changes leading to the mental states alleged to supervene and hence deserving of our experimental attention."

The last stage of yoga includes the four stages of sense-withdrawal, concentration, contemplation, and trance. In concentration, the purpose is to transcend the activities and fluctuations of the *citta* or mind-stuff. The ideal is not reached until all thoughts are suppressed. In practice, after a few rounds of deep breathing in one of the meditative postures, the yogin withdraws his senses from the world and falls into a kind of reverie. "The mind becomes a disinterested spectator of its own processes." Thereafter he observes his thoughts discreetly. Thoughts are the fluctuations or modifications of the mind-stuff. The aim is to reach the pure self which slides behind them. Accordingly, attention is directed towards increasing the interval between thoughts. If a flower is chosen as the object of concentration, it should be reduced mentally to a point and kept before the mind as a mere idea. Another method is to repeat some sacred word like "ÖM." In the final stage the ultimate truth dawns on the yogin and the purusha (soul) abides in itself.

It is not until the last chapter that the author begins to describe any attempt at experimental study. Quite properly he warns the reader against "an over-enthusiastic evaluation of our results," which consist of a few experiments in which he was the only subject. He employs five mental tests to determine "what is the effect on the mind" of thirty minutes of one variety of breathing with, as well as without, twenty minutes of subsequent concentration. He concludes that the influence of the concentration period is to increase the test time, in comparison with that required following the breathing period alone. Both the breathing and concentration tend to decrease the mental functions. Here he comments that the yogic contention that by these practices the mind is turned "inward and detached" from the external waking life is to some extent confirmed by his results. He states that it is difficult to refrain from concluding that there is



a similarity between the neuromuscular condition under yogic breathing and concentration, on the one hand, and the state of relaxation and reduced tensions indicated by the above experiments, on the other.

Here evidently the author assumes that relaxation is the only factor that might account for increased time in the mental tests. However, obviously other factors may be present in yogic practice, such as over-oxygenation, if not partial asphyxia, distraction, or some sort of trance state. According to the experience of the present reviewer, holding or controlling the breath is a process of tension which does not commonly lead to a maximal state of relaxation of the chest musculature. "Concentration" by directing the gaze towards the tip of the nose or elsewhere likewise is not relaxing. The author's description of yogic practices makes clear that there are no sufficient grounds for the claim that they achieve therapeutic results through the development of a state of relaxation. Lacking objective record of muscle tensions during breathing and concentration, the author fails to establish anything concerning the physiology of yogic practice.

The author finds his own rates of oxygen consumption in several types of yogic breathing increased over ordinary breathing. He relates how his own health has been much improved by yogic practices so that he no longer has headaches nor lack of "pep," but instead has an increase in his "resistance capacity" or "power of endurance." He states that a half dozen yogins were the happiest personalities he had ever known, and he then proceeds to quote William James and also Cannon. These asseverations are scarcely better evidenced than those heard in the testimonial meetings of the Christian Science church. He finishes with the admission that the metaphysics of yoga "are an audacious and poetic leap in the dark."

It seems safe to predict that most readers will not be tempted to give years of study in order to learn to vomit at will or to roll the tongue backward and upward so as to cover up the nasal cavities posteriorly, requiring that the frenum of the tongue be cut little by little once every week. Many also will doubt if it is worth the candle to acquire skill in contracting and relaxing the anal and urinary sphincters so as to be able to wash the colon and bladder at will. Here we may include the practice of swallowing a long piece of cloth so as to cleanse the stomach and massage its walls. This short sighted reviewer is inclined to the belief that on the basis of a philosophy the yogin engages in special practices which include hypnoidal and trance states, eventually coming to live in a world

apart. He evades what the occidental world knows as reality, finding in his own mind-castles a sort of ecstasy in preparation for the world beyond. The results are more nearly comparable to certain types of insanity which show features of quiet satisfaction or even of ecstasy than they are to normal physiological conditions as restored by effective modern methods of therapy.

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MENNINGER, KARL A., *The Human Mind*. (Second Edition.) New York: Alfred A. Knopf, 1937. Pp. xiii+504+xiii.

In discussing the revised edition of a work as well known as Dr. Menninger's *The Human Mind* for the professional psychologist, the reviewer may well concentrate on the character and quality of the revision. For this semi-popular presentation of modern psychiatry, which so nearly fulfills the motto "*Vulgariser sans Abaisser*," must have been read by nearly all members of the profession since its appearance in 1930. It is a promising sign for the social utility of mental science that a work on psychology written without compromising scientific knowledge and without making promises of concrete social or material dividends should circulate up to nearly two hundred thousand copies. A promising sign, because it shows that scientific psychology may be presented in such a way as to compete on an almost equal basis with the works of the quacks and the charlatans.

The revision is a thorough one and not, as so often is the case, a job of scissors, paste, new footnotes, and bibliographical addenda. Much of the text has been rewritten and many of the chapters expanded to keep pace with the times. The more consistent use of the psychoanalytic theories of motivation and personality structure in the new edition give the book a more systematic theoretical background.

Academic psychologists will note with some satisfaction that Dr. Menninger's strictures on the sterility of the psychology of the university laboratories have been toned down considerably. But this is not only due to a tolerance which increases with maturity. The academic psychologists have themselves been more and more concerned with problems of vital significance in the last several years. The treatment of heredity and environment is expanded and cognizance taken of the view increasingly held in the advanced psychological laboratories that the old debate, heredity vs. environment, is

an example of a meaningless antithetical dichotomy. The chapter on "Treatment" is improved by a more adequate discussion of psychoanalytic procedure in relation to other techniques. The reviewer believes that Dr. Menninger is perhaps unduly enthusiastic about the growing improvement in psychiatric prognosis. Perhaps the improved prognostic statistics of which the psychiatrist is, quite understandably, so proud are subject to the same sources of error which we recognize in the statistics relative to the increase in mental illness. At all events, neither Dr. Menninger (nor anyone else so far as the reviewer knows) has presented conclusive evidence that improved recovery rates are directly correlated with improved therapies. The chapter on "Applications" includes a new, restrained, and well-balanced discussion of the implications of psychiatry for religion. In this chapter the section on "Educational Applications" is likewise expanded. The revised edition ends with a topical bibliography of around 250 titles. The usefulness of this bibliography for the uninitiated would have been greatly improved by the addition of brief descriptive notes. The works chosen vary greatly in both stylistic and technical level. The beginner choosing from these works at random will certainly meet some confusion.

The sort of change already mentioned is prerequisite to any good revision. Dr. Menninger does more than this, however. In 1930 his position was that of the eclectic psychiatrist rather sympathetic to Freudian theory. In 1937 his position is that of the psychoanalyst. Consequently his treatment of motivation, which is central to the whole argument, is made much more systematic in the Freudian sense. This, the reviewer believes, is a great improvement. No matter what we academic psychologists may say about the methodological shortcomings of psychoanalysis, we are gradually coming to realize that the psychoanalytic theories deal in a systematic fashion with nearly all important psychological problems. What was originally a theory of the neuroses has grown into the one contemporary psychology which attempts an integration of normal with psychotic, neurotic, sexually perverse, and characterologically defective behavior. The theory thus furnishes a framework on which we may hang the most varying psychological data. Dr. Menninger presents Freudian theory in a judicious and temperate manner. And the psychoanalysis presented is the 1937 model—not as so often in brief popular presentations, that of 1905 or even 1893. The reviewer regrets only that Dr. Menninger did not go the whole way and present all the various parts of psychoanalytic theory in an integrated whole.

*The Human Mind*, revised edition, is without doubt the best introduction which the reviewer knows to the problems of abnormal psychology and psychiatry. It would make an admirable text for college use, either to supplement the introductory course or for the course in abnormal. It does not, as the publisher's blurbs imply, cover all that is known about the human mind. The academic psychologist still has a great deal which is important to say about perception, learning, and thought not touched upon in Dr. Menninger's book. But it does cover in a conceptually scientific and a stylistically charming manner certain very important aspects of human behavior. Here is a popularization of contemporary psychiatry, conceived with artistry and executed with accuracy and grace.

J. F. BROWN.

*University of Kansas.*

MYERS, CHARLES S., *In the Realm of Mind*. Cambridge: At the University Press; New York: The Macmillan Company, 1937. Pp. 251.

This book, by a leading English psychologist, possesses no fundamental unity; however the author writes most fascinatingly about some of the applications and implications of present day psychology. The chapter headings of the book are indicative of the eclectic character of its subject matter. They are: the help of psychology in the choice of a career, the human factors in accidents, the psychology of musical appreciation, a psychological regard of medical education, the modern development of social psychology, towards internationalism, psychological conceptions in other sciences, the absurdity of any mind-body relation, and the nature of mind. The book is, in fact, a collection of public addresses given before business and educational groups or learned societies in England. The delightful style of the various chapters is due in part, therefore, to the greater informality of the public lecture. Professor Myers' lectures exhibit maturity of thought, and the sobriety and sanity he shows in his psychological evaluations are a refreshing antidote to many of the polemical writings of the day. Presumably the book is intended primarily for the general reader; however, the professional psychologist will find most of the chapters stimulating.

Since it deals with such diverse topics, the book is not easy to review in a short space. Of the various chapters, the psychologist

will probably find the theoretical ones at the end of the book of greatest interest. In any event, the reviewer found them of most moment.

Professor Myers' connection with the National Institute of Industrial Psychology has undoubtedly inspired in him a faith in the practical usefulness of psychology—that psychology may be useful in the judicious choice of a career, that psychology may indicate the importance of human factors in accidents, or that psychological considerations are germane to medical education and to medical practice. Thus, in concluding his discussion of psychology in the choice of a career, the author states that “If we could but bring ourselves to spend on applied psychological work in vocational guidance even what we now spend in forecasting the weather, or, still more, on testing factory materials and machines, what untold happiness and economies would result!” and that scientific vocational psychology bids fair to render predictions in this field as reliable as the predictions of the meteorologist.

Something of the author's intellectual versatility is shown in his treatment of the complex problem of internationalism, where a knowledge of social, political, economic, biological, and psychological factors is a necessary part of one's mental furniture to insure a sober and balanced discussion. We have a long way to go to achieve an “international mind,” but we are perceptibly nearer this ideal than we were a hundred years ago. Myers would not insist that the individual person shows improvement, but that his thoughts, sentiments, and conduct depend in large part upon the social mental environment of which he is a part, and that “it is that environment which—despite momentary interludes of violent, jealous nationalism—is slowly moving in the direction of a wiser internationalism.”

In his discussion of the mind-body relation, the author dismisses parallelism, interactionism, and material or spiritual monism, and argues that a separation of and antagonism between living body and mind is unfounded. We are only justified in drawing a distinction between the living organism and the lifeless universe. Mental activity and bodily activity are identical, and the “most highly specialized forms of these two activities are, respectively, conscious processes and the processes of the living brain matter.” Direction and mechanism are universally widespread, and each is an abstraction totally different from the other. Both conceptions are derived from conscious mental experience, and “directive activity is not confined to



the living organism, any more than mechanical activity is confined to the physical universe."

The format is pleasing, and the book is exceptionally well written. In the opinion of the reviewer, any psychologist would enjoy a profitable evening in perusing this small volume.

PAUL L. WHITELY.

*Franklin and Marshall College.*

PRESSEY, S. L., and JANNEY, J. E., *Casebook of Research in Educational Psychology*. New York: Harper and Brothers, 1937. Pp. xviii+432.

The authors present in abbreviated form the method and significant data and conclusions of seventy-five studies selected largely from psychological and educational periodicals. The studies cover a wide range of subject matter and are grouped under twelve headings: namely, health; interests and incentives; problems of social adjustment and of emotional stress; intelligence; adjustment to individual differences; some problems of educational measurement; types of learning; efficiency in learning; attitudes and character traits; transfer of training; fatigue; the results of schooling. Under each of these headings is a number of studies dealing with different aspects of the topic.

The selected studies include many of the standard references as well as a number of interesting studies that have become covered up in the vast bulk of experimental literature in the field. Bringing such to light in a briefer and less tedious form than is characteristic of the usual journal report is a very worthy achievement. The selection, editing, and arrangement of the studies has been well done, although the reader regrets some of the omissions in the studies with which he is familiar. The book repeatedly forces one back to the original studies in order to fill in certain gaps or even to see whence certain conclusions have been derived. This is anything but a fault in a book which is intended to stimulate an interest in research. There is a rather noticeable absence of experiments which yield contradictory results, but such are scarcely to be expected in a book of this scope.

The authors have been rather sparing in their own discussion of the studies and on this account the book lacks general coherence. Each study stands largely by itself with only a limited coördination brought about by the grouping and by general summaries which largely repeat the findings of the experiments. Apparently it was

the intention of the authors to leave the more general inferences to the reader, and in fact they are not difficult to draw in the majority of instances.

The fundamental variability of human acting and thinking not only makes scientific investigation difficult in the fields of education and psychology but in addition necessitates that the conclusions reached be interpreted and critically evaluated in terms of the conditions under which the investigations were carried out. All too frequently in educational psychology valid conclusions are discredited and sometimes invalid ones accepted because books on the subject present conclusions without a description of the method whereby the facts upon which the conclusions are based were derived. Moreover readers are frequently unaware of how widely scientific findings vary in reliability. This casebook presents a sampling of experimental studies and as such one of its principal values is to inform the reader of the wide differences which exist between educational studies with regard to how adequately they meet the requirements for scientific investigation. Such differences are amply represented by the studies dealt with but no critical appraisal is supplied by the authors. This is unfortunate because students frequently are incapable of distinguishing between poorly and well conducted studies. They require guidance in the critical evaluation of experimental procedures. The authors can scarcely be blamed for this lack since the majority of investigators would not welcome their studies being quoted as examples of inadequate experimental procedure. The alert instructor may correct this deficiency by pointing out to his students several instances where the data do not justify the conclusions reached or where the procedure followed has been faulty. The authors do point out that they did not restrict the studies included to those which they considered "exemplary as to method." This is sound, because one of the principal reasons for making a study of scientific method is to appreciate just how inadequate scientific investigations can be on occasion. However the reader wishes that the authors had felt free to offer their own critical appraisal of these studies.

To indicate the practical significance of experimental findings is a highly important task. Pressey did this very acceptably in his *Psychology and the New Education*. Pressey and Janney are performing the same task in this book but in a different manner in that their emphasis is upon method and the general value of experimentation in education. In the introductory and concluding chapters they refer convincingly to the value of such experimentation. Sometimes

they give the impression that experimentation in education and psychology is easier than it actually is.

The book will be of definite value to those who are teaching, studying, or just generally interested in education or psychology. It is on a distinctly higher level but is fully as interesting and enjoyable as the current digests, which are read so widely.

S. N. F. CHANT.

*University of Toronto.*

LUNDHOLM, HELGE, *The Psychology of Belief*. Durham, N. C.: Duke University Press, 1936. Pp. vii+245.

This latest monograph from the leading contemporary expositor of hormic psychology presents a workmanlike analysis of three phases of the problem of belief: belief engenderment, the nature of belief as enduring mental disposition guiding conduct, and belief as a mode of experiencing. Lundholm has rejected, except for the isolated instance of post-hypnotic suggestion, the conventional appeal to authoritative suggestion as the chief agent in developing beliefs, and argues that for a permanent belief there must be an association of the believed-in object or situation with the impulses of desire or aversion. This constitutes the *emotional principle* and is the primary begetter of belief. Correction of beliefs occurs when the *rational principle* begins to operate, *i.e.* when objects cease to be apprehended in relation to the ego and are apprehended in relation to other objects. It is the constant interplay of these two principles, the emotional and rational, which determines the structure of beliefs as mental dispositions. The ego-object apprehension is genetically primary, and only later does object-object apprehension develop as a maturing function of "primordial curiosity," one of the three general impulses (curiosity, sleep, deference) which underlie the special impulses (instincts). Beliefs are true if they satisfy James' pragmatic criterion of being "invaluable instruments of action" and are false if they do not; the various sub-universes of truth are fully recognized. Three chapters dealing with normal self-deception, manic-depressive and schizophrenic delusions are presented primarily as evidences of the validity of the author's earlier contention that the emotional and rational principles are responsible for belief-content. Both manic-depressive and schizophrenic delusions result from the diminution of the rational principle; they are conceived as differing primarily in that the diminution in manic-depressive psychosis follows on a toxic depression of the

higher cerebral centers while in schizophrenia repression is the responsible agent. One particularly important systematic contribution, from the hormic point of view, is the logical proof that an object perceived is necessarily an object believed.

The discussion of the nature of belief as an enduring mental disposition guiding conduct and as a mode of experiencing are equally thorough; it is impossible to do justice to the details of logical analysis in a brief review. Lundholm has gone far beyond his great predecessors in the careful analysis of the implications of the hormic position, and this examination of belief fills a need which has often been stressed by the critics of that school. But in spite of this new infusion of logic in purposivism the epistemological implications of thorough-going mind-body interactionism are no more satisfying to an experimental psychologist than before. Such classificatory rubrics as the *emotional* and *rational principles* add little to an analytic explanation of behavior; indeed the analogues of these very principles have, since the earliest attempts at systematization, hindered the development of scientific psychology by presenting complete antithesis where even within their own frame of reference only partial antithesis existed. English psychology with Stout, Bain, Ward, and McDougall was essentially speculative and its successor, hormic psychology, lacks completely the atmosphere of experiment notwithstanding a repetitive but inadequate appeal to biological evolution. If the goal of psychology be some kind of ordered understanding of human behavior one can make no criticism of the hormic system, for there is no sound criterion for judging what is an "ordered understanding." But if psychology, in keeping with every other science, sets its cap for rigorous definition, adequate measurement, and predictive power; if, in short, it is to be a natural science rather than an esthetic delight, hormic psychology has to date offered little. Evidence is still lacking that its conceptions can be *invaluable instruments of action* either in the laboratory or in society itself.

ROBERT R. SEARS.

*Yale University.*

RIVLIN, H. N., *Educating for Adjustment*. New York: D. Appleton-Century Company, 1936. Pp. xiv+419.

The book justifies its subtitle: *The Classroom Applications of Mental Hygiene*. It is addressed to the teacher, the supervising teacher, and the principal. It makes no particular appeal to the

systematic psychologist except as he may be interested in observing an artful application of psychological and psychiatric principles to educational practices. To this end the book should please rather than antagonize the academic psychologist.

The book differs from Shaffer's (*The Psychology of Adjustment*), for example, in that it is addressed to the teacher rather than to the psychologist. In object, it resembles Sherman's *Mental Hygiene and Education*. It resembles both of these books in that it is free from extravagant claims. Any book which deals with the applications of psychology must go beyond what is experimentally verified. However, Rivlin's book appeals to the reader as giving good advice. Comparatively few of the suggested applications seem to be strained or far-fetched. It is conservative in tone and should prove to be very helpful to the teacher—which is its object.

In the introductory chapters the author states the need of a mental hygiene approach to educational problems and practices. In the giving of many practical suggestions throughout the later chapters he gives the impression that the program he advocates is adequate, in a material measure, to meet the need. His suggestions are practical and made in usable form. The book deals with the everyday problems of adjustment. It makes no attempt to instruct the teacher in the art of dealing with psychotic symptoms. In fact, the teacher is repeatedly warned not to undertake such a program.

The book devotes a chapter to various psychoanalytical approaches to the study of conduct disorders—those of Freud, Adler, and Jung—and a chapter to the psychological approach. The suggested procedures incline more to common-sense than to any particular systematic approach to the problems. The listing of the following chapter titles will suffice to give further impression of the scope of the book: "Mental Hygiene in the Classroom," "Emotional Stability," "Physical Factors Affecting Adjustment," "Reducing the Conflict Between Home and School," "Easing Environmental Stresses," "Mental Hygiene and Classroom Discipline," and "The Use of Incentives." Each chapter concludes with a list of conduct and behavior problems for purposes of discussion and with a selected bibliography.

J. B. STROUD.

*Kansas State Teachers College of Emporia.*



## BOOKS RECEIVED

ADLER, M. J., *What Man Has Made of Man*. New York: Longmans, Green and Company, 1937. Pp. xix+246.

ANDERSON, C. M., *Emotional Hygiene: The Art of Understanding*. Philadelphia: J. B. Lippincott Company, 1937. Pp. ix+242.

CROTHERS, B., *A Pediatrician in Search of Mental Hygiene*. New York: The Commonwealth Fund, 1937. Pp. xix+271.

DIMOCK, H. S., *Rediscovering the Adolescent: A Study of Personality Development in Adolescent Boys*. New York: Association Press, 1937. Pp. xx+287.

EISNER, H., *The Classroom Teacher's Estimation of Intelligence and Industry of High School Students*. T. C. Contr. to Educ., No. 726. New York: Bureau of Publications, Teachers College, Columbia University, 1937. Pp. 108.

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FRENKEL, E., and WEISSKOPF, E., *Wunsch und Pflicht im Aufbau des Menschlichen Lebens. Psychologische Forschungen über den Lebenslauf*, Band I. (Edited by Charlotte Bühler and Else Frenkel.) Wien: Gerold and Company, 1937. Pp. 163.

FREUD, ANNA, *The Ego and the Mechanisms of Defence*. London: The Hogarth Press and the Institute of Psycho-Analysis, 1937. Pp. x+196.

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KELLER, F. S., *The Definition of Psychology*. New York: D. Appleton-Century Company, 1937. Pp. vi+111.

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LUCKIESH, M., and MOSS, F. K., *The Science of Seeing*. New York: D. Van Nostrand Company, Inc., 1937. Pp. viii+548.

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PETRONIEVICS, B., *Résumé des travaux philosophiques et scientifiques*. *Bulletin de l'Académie des Lettres*, No. 2. Belgrade: Académie Royale Serbe, 1937. Pp. v+328.

SLETT, R. F., *Construction of Personality Scales by the Criterion of Internal Consistency*. Hanover, New Hampshire: The Sociological Press, 1937. Pp. vii+92.

SOUTHALL, J. P. C., *Introduction to Physiological Optics*. New York: Oxford University Press, 1937. Pp. x+426.

## NOTES AND NEWS

PROFESSOR ROSWELL P. ANGIER, chairman of the department of psychology at Yale University, has been appointed associate dean of the Graduate School.—*Science*.

DR. BUFORD JOHNSON, professor of psychology at the Johns Hopkins University, will retire at the close of the academic year.  
—*Science*.

APPLICATIONS for the Elizabeth Clay Howald Scholarship must be filed with the dean of the Graduate School, Ohio State University, Columbus, Ohio, not later than March 1, 1938. The appointment will be made on April 1 and the term of appointment will begin July 1, 1938, and extend to July 1, 1939.

This Scholarship, endowed by the late Ferdinand Howald, an alumnus of the Ohio State University, in memory of his mother, Elizabeth Clay Howald, carries a stipend of \$3,000 payable in twelve monthly installments. Any person who has shown marked ability in some field of study and has in progress work, the results of which promise to constitute important additions to our knowledge, shall be deemed eligible to appointment.

THE Society for the Psychological Study of Social Issues has authorized the preparation of a yearbook entitled *The Psychology of Industrial Conflict*. The responsible committee (listed below) is interested in securing fresh, concrete field data or documents bearing upon this problem from workers, employers, public officials, and social scientists working in specialized fields. A tentative outline is available, and qualified persons who wish to coöperate in this enterprise either by submitting hitherto unused materials or by contributing to the writing of parts of the text should communicate with any of the following: Theodore Newcomb, Bennington College, Bennington, Vermont; Keith Sward, People's Press, New Kensington, Pennsylvania; George W. Hartmann, Teachers College, Columbia University (Chairman).